The Effect of Human-Immunodeficiency Virus Status on Outcomes in Penetrating Abdominal Trauma: An Interim Analysis

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Abstract: BACKGROUND The purpose of this study was to determine whether the outcomes of hemodynamically stable patients undergoing exploratory laparotomy for penetrating abdominal trauma differed as a result of their HIV status. METHODS This was an observational, prospective study from February 2016 to May 2017. All hemodynamically stable patients with penetrating abdominal trauma requiring a laparotomy were included. The mechanism of injury, the HIV status, age, the penetrating abdominal trauma index (PATI), and the revised trauma score (RTS) were entered into a binary logistic regression model. Outcome parameters were in-hospital death, morbidity, admission to intensive care unit (ICU), relaparotomy within 30 days, and length of stay longer than 30 days. RESULTS A total of 209 patients, 94% male, with a mean age of 29 ± 10 years were analysed. Twenty-eight patients (13%) were HIV positive. The two groups were comparable. Ten (4.8%) laparotomies were negative. There were two (0.96%) deaths, both in the HIV negative group. The complication rate was 34% (n = 72). Twenty-nine patients (14%) were admitted to the ICU. A higher PATI, older age, and a lower RTS were significant risk factors for ICU admission. After 30 days, 12 patients (5.7%) were still in hospital. Twenty-four patients (11%) underwent a second laparotomy. The PATI score was the single independent predictor for complications, relaparotomy, and hospital stay longer than 30 days. CONCLUSIONS Preliminary results reveal that HIV status does not influence outcomes in patients with penetrating abdominal trauma.

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Title

The effect of human-immunodeficiency virus status on outcomes in penetrating abdominal trauma – an interim analysis

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Abstract

Background: The purpose of this study was to determine whether the outcomes of hemodynamically stable patients undergoing exploratory laparotomy for penetrating abdominal trauma differed as a result of their HIV-status.

Methods: This was an observational, prospective study from February 2016 to May 2017. All hemodynamically stable patients with penetrating abdominal trauma requiring a laparotomy were included. The mechanism of injury, the HIV-status, age, the penetrating abdominal trauma index (PATI), and the revised trauma score (RTS) were entered into a binary logistic regression model. Outcome parameters were in-hospital death, morbidity, admission to intensive care unit (ICU), relaparotomy within 30 days, and length of stay longer than 30 days.

Results: A total of 209 patients, 94% male, with a mean age of 29 ± 10 years were analysed. Twenty-eight patients (13%) were HIV positive. The two groups were comparable. Ten (4.8%) laparotomies were negative. There were two (0.96%) deaths, both in the HIV negative group. The complication rate was 34% (n=72). Twenty-nine patients (14%) were admitted to the ICU. A higher PATI, older age, and a lower RTS were significant risk factors for ICU admission. After 30 days, 12 patients (5.7%) were still in hospital. Twenty-four patients (11%) underwent a second laparotomy. The PATI score was the single independent predictor for complications, relaparotomy and hospital-stay longer than 30 days.

Conclusions: Preliminary results reveal that HIV-status does not influence outcomes in patients with penetrating abdominal trauma.

Introduction

HIV infection and trauma are significant contributors to the burden of disease in South Africa. More than 70 million people worldwide have been infected with the Human Immunodeficiency Virus (HIV) since 1981; half of them have since died.[1] Seven million people with HIV were living in South Africa in 2016.[2] In 2010, HIV/AIDS accounted for the leading cause of death in Cape Town (13%), followed by interpersonal violence (9.7% - mainly penetrating injuries) and tuberculosis (7.7%).[3] Although HIV and the acquired immunodeficiency syndrome (AIDS) can potentially affect outcomes, there have been few studies comparing trauma outcomes in HIV positive versus HIV negative patients. The association between HIV and the outcome of surgery remains unanswered with many studies yielding conflicting results. HIV treatment has also made paramount improvements in the past decades and as a result, HIV positive patients can now live a normal life. Despite this, in some previous studies there seems to be a tendency towards a higher morbidity and mortality in HIV positive patients undergoing trauma surgery.[4-7] While some of these studies did compare HIV positive to HIV negative patients, they considered all mechanisms of trauma and did not differentiate between blunt and penetrating injuries. No studies have been conducted on penetrating abdominal trauma and the influence of HIV on outcomes. The senior authors of this study experienced anecdotally that the HIV status of trauma patients did not influence the outcome, however it seemed that patients with AIDS had poorer results.

The primary purpose of this study was to determine whether the HIV status of hemodynamically stable patients undergoing exploratory laparotomy for penetrating abdominal trauma had any influence on outcomes. The secondary objectives of the study were to determine whether CD4 count in the HIV positive patients plays a role in the outcome of these patients. ~~The endpoint of this study is to provide general and trauma surgeons performing trauma laparotomy with some insight on the expected outcomes of procedures for a HIV positive patient with major penetrating abdominal trauma.~~

Material and Methods

In a prospective, observational study from February 2016 to May 2017 ~~(16 months)~~, all patients admitted with a penetrating abdominal injury requiring a laparotomy at a Level I trauma centre in Cape Town, South Africa, were considered for inclusion in this study. This study was approved by the human research ethics committee (HREC: 819/2015) of the University of Cape Town and Groote Schuur hospital.

The inclusion criteria was hemodynamic stability, penetrating abdominal trauma with an inherent need for laparotomy as result of a peritonitic abdomen, a signed informed consent, and a HIV test. Patients who had more than one area of penetrating trauma, as well as patients with blunt trauma elsewhere were included in the study, as long as the other inclusion criteria were met. Patients undergoing a damage control procedure at the index operation were excluded. However, the attending surgeon may have opted for a damage control procedure in the patient who was initially hemodynamically stable, and these patients were also included in the study. All patients were treated as per our institutional protocol and received the same presumptive preoperative antibiotic coverage, postoperative analgesia and antibiotic regimen.

Safety measures including gloves, googles, and protective wear are routinely used. A standard post-exposure prophylaxis procedure is in place in our trauma unit for ALL health care providers in our hospital in case of a needle-stick injury or exposure to bodily fluids. Blood tests of the exposed and source person is obtained. A highly active antiretroviral 3-drug regimen is commenced within 1-2 hours of exposure. Further treatment is based on source patient status and the healthcare worker is further followed up by occupational health department for counselling and further management.

Once it was clinically determined that the patient required a laparotomy, informed consent for surgery was taken. As it was a concern that these individuals would be vulnerable at the time of going for surgery, participants for the study were recruited post-operatively. Pre- and post-test counselling for HIV testing was done by trained medical practitioners. A standardized counselling form was used. Those individuals with known HIV positive status before inclusion in the study were retested. The HIV test was done after the patient had surgery performed. This was to ensure that patients completely understood the study, would not feel vulnerable and would be able to give proper informed consent. The CD4 count was also performed post-operatively after the HIV test was done, and was confirmed positive. The HIV testing was done with ELISA testing and in cases where the test was confirmed positive, a confirmatory test was done as is in line with provincial guidelines. All newly diagnosed HIV positive patients are eligible for ART (local provincial guidelines of the Western Cape published at http://www.mic.uct.ac.za). Newly diagnosed HIV positive patients are not routinely commenced on antiretroviral therapy during the index hospitalization. It has been found that the compliance rate is significantly better when the ART is started at their local clinic where they can be regularly followed up. Therefore, patients were referred to a local clinic for further HIV counselling and treatment once they were discharged. A 3-drug regimen is commenced and the monitoring process is clearly described at the above website.~~Newly diagnosed HIV positive patients are not routinely commenced on antiretroviral therapy as per provincial guidelines. Once patients were discharged they were referred to a local clinic for further HIV counselling and treatment.~~

Basic demographics, mechanisms of injury, laparotomy findings, estimated intra-operative blood loss, length of hospital stay, admission to ICU, morbidity and mortality were recorded. The Charlson Comorbidity Index (CCI) was used to calculate the severity of comorbidities.[8] Injury severity was categorized calculating the physiological scores (Revised Trauma Score (RTS) and Kampala score[9, 10]), and the anatomical scores (American Association for the Surgery of Trauma (AAST), Abbreviated Injury Scale (AIS)[11], Injury Severity Score (ISS),

and Penetrating Abdominal Trauma Index (PATI)[12]). Complications were grouped according to the Clavien-Dindo classification.[13] Hemodynamically stable patients had a systolic BP greater than 90mmHg. Responders were patients with an initial BP lower than 90mmHg, however stabilized after 1-2-litres of fluid. A peritonitic abdomen was based on the physician's clinical judgement.

The primary outcome was morbidity defined as presence of one or more complications. Secondary outcomes were in-hospital death, admission to intensive care unit (ICU), relaparotomy within 30 days, and length of stay. The patients were stratified into two groups, HIV negative and HIV positive, for the analysis. The association between the CD4 counts, CDC stage, and morbidity in the HIV positive group were further analysed.

A sample size of 205 patients was needed to achieve a power of 80% and type I error rate of 5%, if the complication rate of the HIV negative group is 7% [4, 7], the sampling ratio of HIV negative : HIV positive is 9, and we assume a clinically relevant difference of 7% compared to the HIV negative group, that is 14% [4-7]. Continuous data was presented in mean and standard deviation numbers, and categorical data in absolute and relative numbers. Chi-square, ~~T-~~Mann-Whitney U , and Fisher-test, where applicable, were used to do bivariate analysis. HIV status and the bare minimum (patient age, PATI score for anatomic severity, RTS score for physiologic severity, and mechanism of injury) were entered in multivariate binary logistic regression analysis to evaluate HIV as an independent predictor for a negative outcome (morbidity, in-hospital death, admission to ICU, relaparotomy within 30 days, and length of stay longer than 30 days). Since female gender had a low prevalence, this co-factor could not be entered into regression analysis. $P < 0.05$ was considered statistically significant. The Statistical Package for Social Sciences (SPSS, Version 23, IBM Corp., Armonk, NY, USA) was used for statistical analysis.

Results

The cohort consisted of 209 patients, 196 (94%) men and 13 women, with a mean age of 29 (SD +/-10) years. Twenty-eight patients (13%) were HIV positive. We diagnosed 21 new positive HIV cases. Seven patients were aware of their HIV status prior to this admission. None of them were on ART. The HIV positive and negative groups were comparable except for race, Charlson Comorbidity Index score, and admission delay.(Table 1) All patients underwent an exploratory laparotomy. Of these, 10 (4.8%) were negative or non-therapeutic. Six patients (2.9%) had missed intraabdominal injuries, four with small intestine perforations, one diaphragm laceration, and one bile duct injury.

Morbidity

Seventy-two patients (34%) had one or more complications (Table 2). The three most common complications were: surgical site infections (12%), post-operative ileus (8.6%), and sepsis (6.2%; including intra-abdominal collections, septic shock, urinary tract infections, pneumonia, bullet tract sepsis), which were not significantly associated with the HIV status. There was no noticeable impact of patient age on outcome within the HIV positive (p=0.915) or negative only group (p=0.829). In bivariate analysis, the PATI score (p=0.001), liver packing (p=0.004), splenectomy (p=0.009), colonic resection with primary anastomosis (p=0.036), distal pancreatectomy (p=0.007), wide drainage of the pancreas (p=0.019), nephrectomy (p=0.049), longer duration of the first operation (p<0.001), use of vasopressors intraoperative (p=0.045), need for blood products (p=0.001), and higher estimated blood loss (p=0.001) were associated with morbidity. In multivariate analysis, the PATI score was the only single independent predictor (p=0.001, OR 1.057, 95%CI 1.023 – 1.091) for morbidity. *HIV was not an independent predictor for morbidity.*

Mortality

Two patients (0.96%), both HIV negative, died during the hospitalization, one from hypovolemic shock secondary to rebleeding from a liver injury, and the other one from septic shock from overwhelming sepsis secondary to intraabdominal contamination following a destructive colonic injury. ~~*There was no mortality in the HIV positive group.*~~

Admission to ICU

Twenty-nine patients (14%) were admitted to the ICU. The mean duration of stay was 5.0 (SD +/- 7.3) days, and 3.6 (SD +/- 6.5) days of ventilation. Age (p=0.007), RTS (p=0.014), the Kampala score (p=0.006), the PATI score (p=0.023), thoracoabdominal injuries (p=0.012), insertion of an intercostal drain (p=0.002), liver packing (p=0.029), duodenal repair (p=0.003), wide drainage of the pancreas (p=0.004), longer duration of the first operation (p=0.024), use of vasopressors intraoperatively (p<0.001), need for blood products (p<0.001), and higher estimated blood loss (p=0.004) were associated with admission to ICU. Older age (p=0.07, OR 1.056, 95CI% 1.015-1.098), a higher PATI score (p=0.018, OR 1.043, 95%CI 1.007-1.080), and a lower RTS (p=0.002, OR 0.089, 95%CI 0.020-0.399), *but not HIV status*, were independent predictors for admission to an ICU.

Hospitalization more than 30 days

After 30 days, 12 patients (5.7%) were still in hospital. An acute spinal cord injured patient (p=0.024), drainage of the pancreas (p=0.040), the PATI score (p=0.043), duration of the first operation (p<0.001) and the estimated blood loss (p=0.030) were associated with more than 30 days of hospitalization. PATI score again, was the single independent predictor in multivariate analysis (p=0.001, OR 1.082, 95%CI 1.031 – 1.135).

Relaparotomy within 30 days

Twenty-four patients (11%) underwent a relaparotomy. The reasons were planned (damage control, n=7), new or ongoing bleeding (n=3), intestinal obstruction (n=2), omental evisceration (n=1), multiple intraabdominal abscesses (n=1), peritonitic / septic (n=3), or

other reasons (n=7). The PATI score (p=0.046), liver packing (p=0.006), stomach repair (p=0.041), longer duration of the first operation (p=0.047), use of vasopressors intraoperative (p=0.005), need for blood products (p=0.001), and higher estimated blood loss (p=0.023) were associated with relaparotomy. The PATI score (p=0.003, OR 1.052, 95%CI 1.017-1.088) was again the only significant predictor of relaparotomy.

Other findings

Twenty-two patients had CD4-counts: 31.8% were stage 1 (CD4 count > 500 cells/µl), 36.4% were stage 2 (CD4 count 200-499 cells/µl), and 31.8% were stage 3 (CD4 count <200 cells/µl). *The CDC stage in the HIV positive group was not associated with morbidity* (p=0.380). The average CD4 count in the HIV positive group was 401 +/- 254. It too, was also not associated with morbidity (p=0.234).

Discussion

Globally, 36.7 million people were living with HIV at the end of 2015.[14] South Africa has the highest prevalence in Africa. The Western Cape Province of South Africa, where the study was conducted, has approximately 6.3 million people[2] with a HIV prevalence of 16.9% in 2011.[15] Trauma-related mortality, particularly due to interpersonal violence and road traffic injuries, remains extremely high and specifically amongst young adult males: 170 per 100 000 in age group 20 - 24 years.[16] It is therefore, not uncommon for young adult patients, who are HIV positive, who have sustained some sort of trauma, to be managed in our ~~busy~~ level I urban trauma centre.

The association between HIV and the outcomes of surgery has been previously studied. In 2009, Madiba et al. compared surgery in HIV negative, HIV positive, and AIDS patients and evaluated the outcomes. The results indicated that the outcomes of surgery for patients, who are HIV negative, HIV positive and those with AIDS, are variable in terms of morbidity, mortality, and duration of hospital stay. HIV positive patients without AIDS-defining criteria have a surgical course similar to that of HIV negative patients. HIV infection should therefore not be considered as a significant independent factor for major surgical complications. The study concluded that appropriate surgery should be offered as per normal surgical patients without the concern of an unfavourable outcome.[17] Since 2008, a further dozen reports have compared HIV positive and negative surgical patients. Of all these, only six investigated the trauma population which included predominantly blunt mechanism of trauma (more than 80%). Table 3 is an extended summary of the conclusions of the current available literature on HIV status and surgical outcomes.[3]

In this study, the incidence of HIV is similar to that in the Western Cape Province. In hemodynamic stable patients requiring laparotomy for penetrating abdominal trauma, the

HIV status was not an independent predictor for morbidity, ICU admission, length of hospital stay, and relaparotomy.

A CD4 count greater than 200 cells/μl has been shown to be a good marker of immune function in patients who are HIV positive. ~~Most of our patients were CDC stage 2 (CD4 count between 200 and 500 cells/μl) with an average of 400.~~ With certain limitations, ~~The~~ the CD4 count did not influence outcome of our patients and since none of our patients were on ART during the time of the study, as such did not make a difference in outcome. ~~The CDC staging does not have any impact on the progress and outcome of the patient undergoing an exploratory laparotomy in this study.~~ This is in contrast to previous studies which suggested that the CDC staging has a direct impact on the outcome of the HIV positive patient. In multivariate analysis, the PATI score was the only single independent predictor for morbidity, ICU admission, length of stay and relaparotomy. ~~There were only two deaths, both HIV negative patients, suggesting that HIV was probably not an independent predictor of mortality.~~

Despite the prospective design, the study has several limitations. The viral load was not available due to cost constraints. This could have helped to further stratify the HIV positive patients and allow us to investigate the influence of viral load, if any, on outcomes. Similar, the CD4 counts were measured post-operative and not available in 20%, which makes the CDC staging questionable.

There were 41 patients who refused HIV testing and as such could not be included in our study. Despite adequate counselling about HIV testing, and numerous public health programs underway in the country, including the VCT program (voluntary testing and counselling), there appears to be still a reluctance amongst young adult males to be tested. This must be improved. However, the opt-out approach should be adopted because the overall test rates and disease identification rates were better than with other systems. [18]

Although the mortality rate was very low, we are not able to make any definitive conclusion about HIV status in the current study. To achieve statistical significance in difference in mortality between the two groups, a population of 702 patients is required. The study is still ongoing and recruiting patients for this specific purpose.

In summary, trauma patients with HIV are frequently seen in busy trauma centers in South Africa. We found that the incidence of HIV in our cohort was 13%, which is similar to the reported incidence of HIV in the Western Cape. ~~There were no significant baseline differences between the HIV positive and HIV negative groups.~~ The patient's HIV status ~~as well as the CD4 count~~ did not influence their outcomes in penetrating abdominal trauma and we recommend that these patients be treated as HIV negative patients. The PATI score was found to be a significant predictor of morbidity and was validated in our cohort of patients, as higher PATI scores were associated with poorer outcomes.

Table 1: Overview of Results

Parameter		Total		HIV				
		(n=209)		negative (n=181)		positive (n=28)		p-value
		n	%	n	%	n	%	
Age (years +/- SD)		29	10	29	10	31	9	0.102277
Gender	Male	196	93.8%	172	95.0%	24	85.7%	0.078
	Female	13	6.2%	9	5.0%	4	14.3%	
Race	Black	97	46.4%	75	41.4%	22	78.6%	**0.001**
	Coloured	103	49.3%	98	54.1%	5	17.9%	
	Other	9	4.3%	8	4.4%	1	3.6%	
Charlson Comorbidity index (score +/- SD)		0.10	0.34	0.08	0.31	0.21	0.50	**0.037168**
Mechanism of injury	Gunshot wound	158	75.6%	138	76.2%	20	71.4%	0.771
	Sab	50	23.9%	42	23.2%	8	28.6%	
	Other	1	0.5%	1	0.6%	0		
Admission delay (hours +/- SD)		4.5	7.8	4.4	8.1	5.3	5.4	**0.026463**
Thoracoabdominal injury		54	25.8%	44	24.3%	10	35.7%	0.199
Spinal cord injury		12	5.7%	10	5.5%	2	7.1%	0.666
Haemodynamic stability	Stable	178	85.2%	155	85.6%	23	82.1%	0.577
	Responder	31	14.8%	26	14.4%	5	17.9%	
Presenting hemoglobin		12.4	2.1	12.5	2.1	11.9	2.4	0.165
Presenting white cell count		16.16	6.82	16.38	7.00	14.78	5.53	0.25
Revised trauma score (score +/- SD)		7.743	0.260	7.739	0.269	7.766	0.198	0.529613
Kampala trauma score (score +/- SD)		14	0	14	1	14	0	0.489167
PATI score (score +/- SD)		14	11	14	11	12	7	0.612273
ISS score (score +/- SD)		19	9	18	9	21	9	0.224255
Duration first operation (hours +/- SD)		2.21	1.14	2.21	1.16	2.20	0.99	0.805953
Estimated blood loss (ml +/- SD)		824	947	845	980	675	660	0.637431
Prophylactic antibiotics given?		180	86.1%	154	85.1%	26	92.9%	0.383
Perforation of abdominal organ found at operation		178	85.2%	153	84.5%	25	89.3%	0.775
Bowel resection performed		79	37.8%	66	36.5%	13	46.4%	0.312
Stoma formed		27	12.9%	20	11.0%	7	25.0%	0.063
Morbidity		72	34.4%	61	33.7%	11	39.3%	0.563
Death		2	1.0%	2	1.1%	0		1.0
Admission to intensive care unit		29	13.9%	27	14.9%	2	7.1%	0.383
Still in hospital > 30 days		12	5.7%	12	6.6%	0		0.375
Relaparotomy within 30 days of principle procedure		24	11.5%	23	12.7%	1	3.6%	0.212

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Table 2: Complications according to Clavien-Dindo Classification

Complications		**Total**		**HIV**				**p-value**
				negative		positive		
		n	%	n	%	n	%	
None	No	137	65.6%	120	66.3%	17	60.7%	0.563
Grade	I	12	5.7%	11	6.1%	1	3.6%	
	II	23	11.0%	17	9.4%	6	21.4%	0.105
	IIIa	11	5.3%	9	5.0%	2	7.1%	
	IIIb	13	6.2%	12	6.6%	1	3.6%	
	IVa	3	1.4%	3	1.7%	0	0.0%	
	IVb	8	3.8%	7	3.9%	1	3.6%	
	V	2	1.0%	2	1.1%	0	0.0%	

Table 3: Overview of studies comparing surgical HIV negative and HIV positive patients

Authors	Country	Year	N	Discipline	Conclusions
Non trauma					
Wakeman et al.[19]	UK	1990	112	General surgery, elective and emergency, including sepsis	HIV positive patients have a slower wound healing
Safavi et al.[20]	USA	1991	62	Anorectal diseases, including septic and non-septic	AIDS patients have a poor healing
Ayers et al.[21]	USA	1993	343	All surgical disciplines	No relevant differences in outcomes
Binderow et al.[22]	USA	1993	25	General surgical patients	AIDS patients have a higher mortality
Devito and Robinson[23]	USA	1995	62	Gynecological surgery	No relevant differences in outcomes except a higher blood loss in HIV positive patients
Consten et al.[24]	The Netherlands	1995	83	Anorectal diseases, including septic and non-septic	AIDS patients with a lower CD4 cells count have a disturbed wound healing
Yii et al.[25]	Australia	1995	45	General surgery including emergencies	AIDS patients have a higher morbidity
Hewitt et al.[26]	USA	1996	57	Hemorrhoidal disease	No relevant differences in outcomes
Bhagwanjee et al.[27]	South Africa	1997	402	Surgical critical care	HIV positive patients have more often organ failure and septic shock - **54% were trauma cases, mostly penetrating, with no mortality difference at discharge**
Lord et al.[28]	Australia	1997	101	Anorectal diseases, including septic and non-septic	HIV positive patients with less than 50 CD4 cells/μl have a poor wound healing
Curi et al.[29]	USA	1999	104	Vascular	HIV positive patients have a higher morbidity
Davis et al.[30]	UK	1999	64	General surgery laparotomy only including 5% trauma	HIV positive patients have more wound dehiscence
Morandi et al.[31]	Italy	1999	48	Hemorrhoidal disease	HIV positive and AIDS patients have a slower wound healing, AIDS patient have a higher morbidity
Nadal et al.[32]	Brazil	1999	1860	Anorectal diseases, including septic and non-septic	AIDS patients have a slower wound healing
Tran et al.[33]	USA	2000	55	All surgical disciplines	No relevant differences in outcomes
Nickas et al.[34]	USA	2000	443	Critical care	AIDS patients have a higher long-term mortality
Jjuuko and Moodley[35]	South Africa	2002	270	Gynecological surgery	HIV positive patients have a higher wound sepsis rate
Lewis et al.[36]	Malawi	2003	445	All medical and surgical admissions with <14% trauma	HIV positive patients have a higher mortality
Mkony et al.[37]	Tanzania	2003		General surgical patients	HIV positive patients have a higher mortality
Narasimhan et al.[38]	USA	2004	441	Critical care	No relevant differences in outcomes
Fiore et al.[39]	Europe	2004	408	Maternal mortality and complications in obstetrics	HIV positive patients have a higher morbidity
Cacala et al.[40]	South Africa	2006	550	General surgical patients	No relevant differences in outcomes
Horberg et al.[16]	USA	2006	704	General surgical patients	No relevant differences in outcomes except a higher pneumonia rate in HIV positive patients
Doumgba et al.[41]	Central African Republic	2006	207	General surgery, elective and emergency cases	HIV positive patients have a higher wound sepsis rate
Martinson et al.[42]	South Africa	2007	537	General surgery including 31% trauma	No relevant differences in outcomes
Dua et al.[43]	UK	2007	477	General surgery including septic and non-septic cases	AIDS patients have a higher morbidity
Ramogale et al.[44]	South Africa	2007	378	Maternal mortality in obstetrics	HIV positive patients have a higher mortality
Masoomi et al.[45]	USA	2011	800	Appendicitis	AIDS patients have a higher morbidity
Cunin et al.[46]	UK	2014	44	Anal cancer	HIV positive patients have a higher morbidity
Feng et al.[47]	China	2015	803	General surgery including 7.5% trauma	Low CD4 count is a risk factor for sepsis
Izadmehr et al.[48]	USA	2016	13	Prostate cancer	No relevant differences in outcomes
Leeds et al.[49]	USA	2016	308	Anal cancer	No relevant differences in outcomes
Phakathi et al.[50]	South Africa	2016	31	Breast cancer	No relevant differences in outcomes
Green et al.[51]	South Africa	2017	675	Surgical septic patients	No relevant differences in outcomes, patients with a lower CD4 cells count have a higher mortality
Trauma					
Guth et al.[52]	USA	1996	53	**Trauma, blunt and penetrating (57%)**	No relevant differences in outcomes
Stawicki et al.[4]	USA	2005	1173	**Trauma, predominantly blunt, penetrating (19%)**	Significant pulmonary and infective complications in HIV positive patients, no difference in mortality
Duane et al.[5]	USA	2008	254	**Trauma, predominantly blunt, penetrating (18%)**	Significant pulmonary and renal complications in HIV positive patients, no difference in mortality
Mayala et al.[53]	Tanzania	2010	250	**Trauma, blunt and penetrating**	HIV positive patients have a higher mortality and a longer lenght of stay
Morrison et al. [6]	USA	2010	1461580	**Trauma, predominantly blunt, penetrating (11%)**	Significant pulmonary complications in HIV positive patients, no difference in mortality
Patel et al.[7]	USA	2011	356448	**Trauma, predominantly blunt, penetrating (< 17%)**	HIV was a significant risk factor for complications, but not for mortality
Salehi et al.[54]	Iran	2017	969	**Burns only**	HIV positive patients stayed longer in the hospital

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